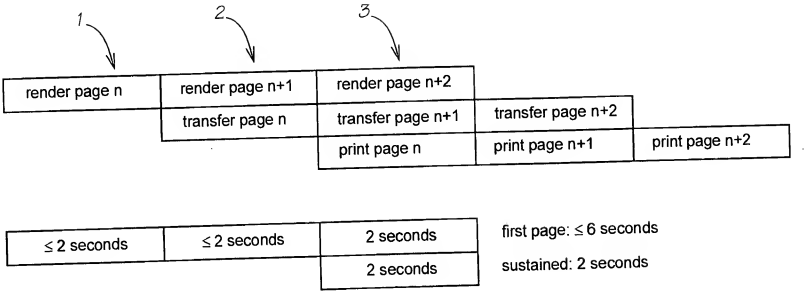

1
2
3
render page n
render page n+1
render page n+2
transfer page n
transfer page n+1
transfer page n+2
print page n
print page n+1
print page n+2
≤ 2 seconds
≤ 2 seconds
2 seconds
2 seconds
first page: ≤ 6 seconds
sustained: 2 seconds

FIG. 1

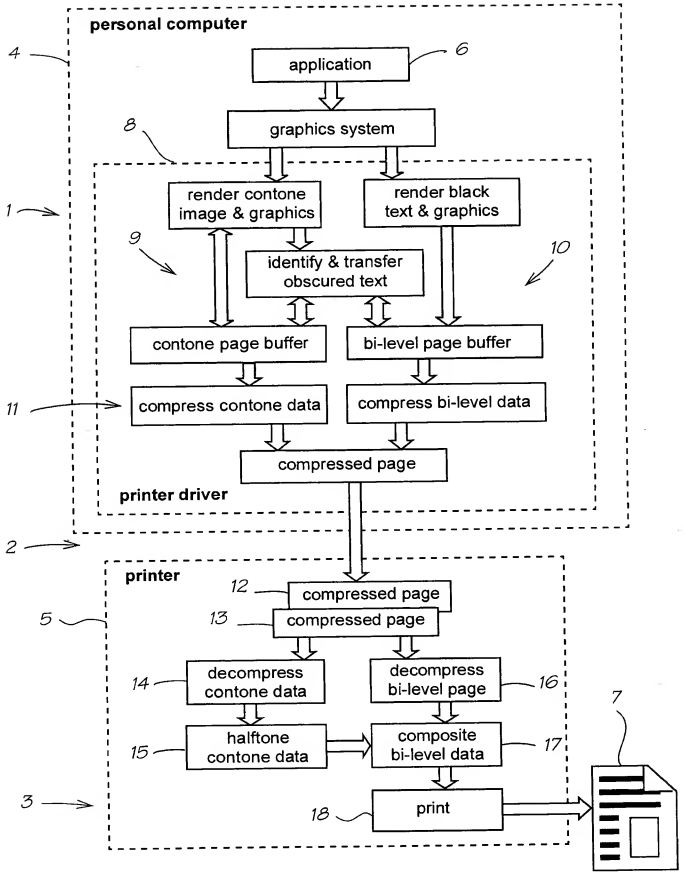

personal computer
4
application
6
graphics system
8
render contone image & graphics
render black text & graphics
1
9
identify & transfer obscured text
10
contone page buffer
bi-level page buffer
11
compress contone data
compress bi-level data
compressed page
printer driver
2
printer
12
compressed page
5
13
compressed page
14
decompress contone data
decompress bi-level page
16
7
15
halftone contone data
composite bi-level data
17
3
18
print

FIG. 2

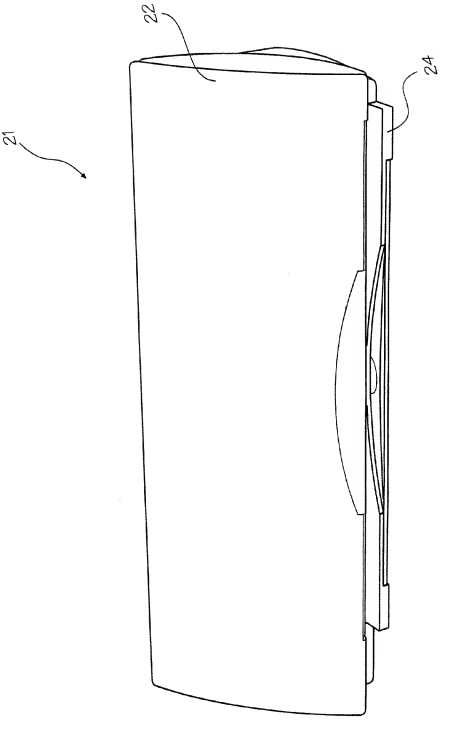


FIG. 3

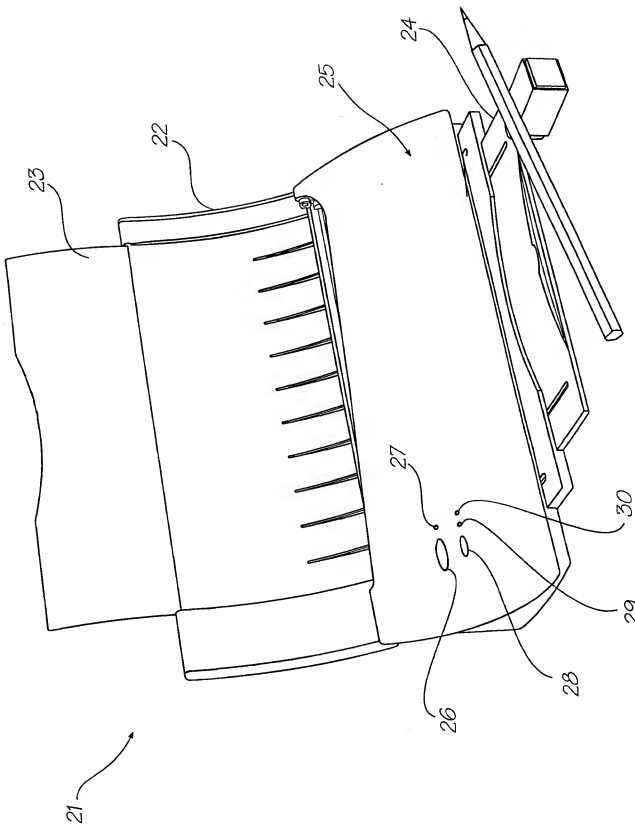


FIG. 4

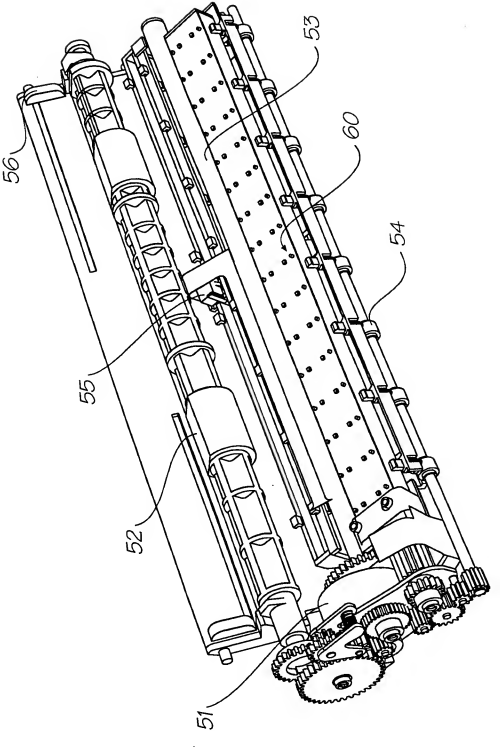


FIG. 5

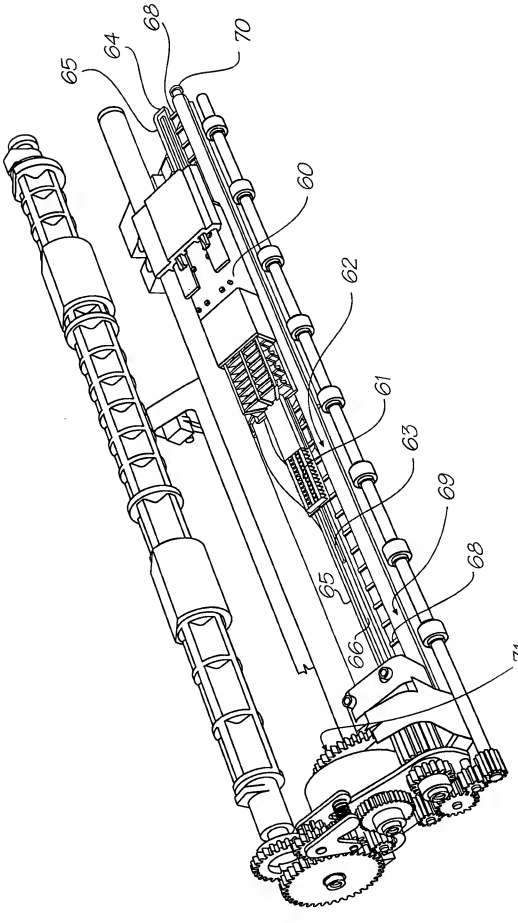


FIG. 6

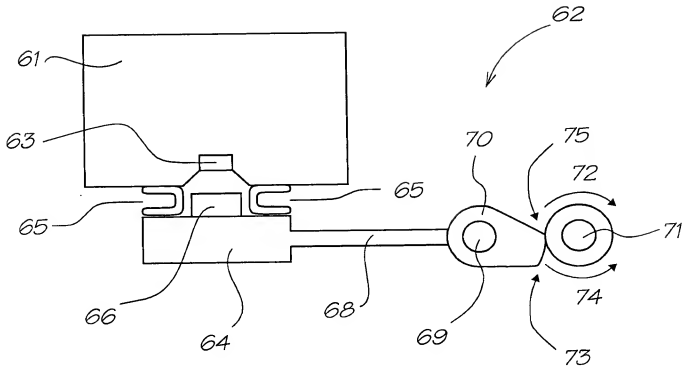


FIG. 7

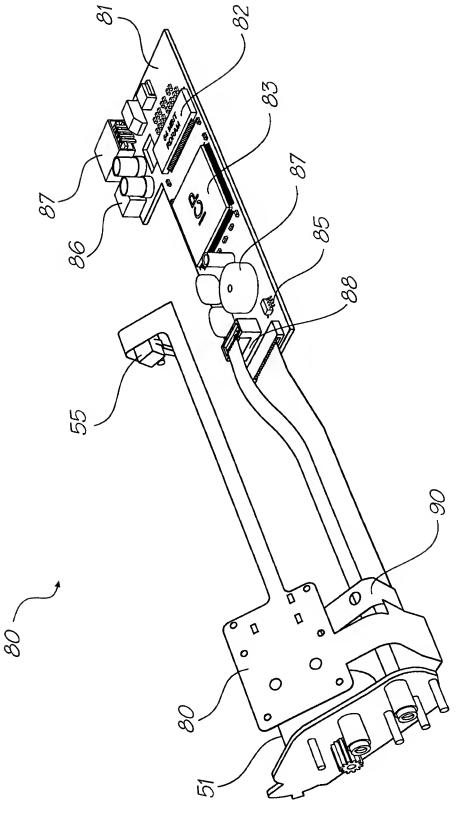


FIG. 8

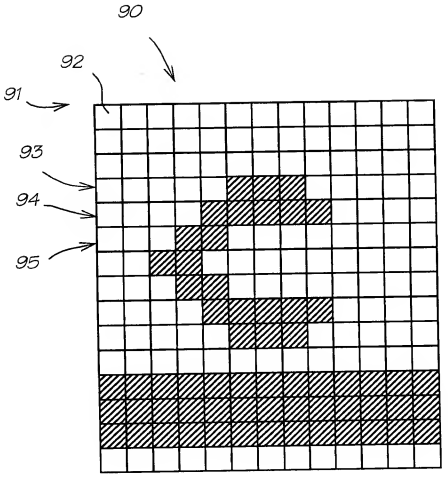

90
92
91
93
94
95
Δ0
Δ0
Δ0
create 5, create 3, Δ0
Δ−1, Δ+1, Δ0
Δ−1, create 2, kill, Δ0
Δ−1, Δ−1, Δ0
Δ+1, Δ+1, Δ0
Δ+1, kill, create 5, Δ0
Δ+1, Δ−1, Δ0
kill, kill, Δ0
create 0, kill, create 13
Δ0, Δ0
Δ0, Δ0
kill, kill, create 13, EOP

FIG. 9

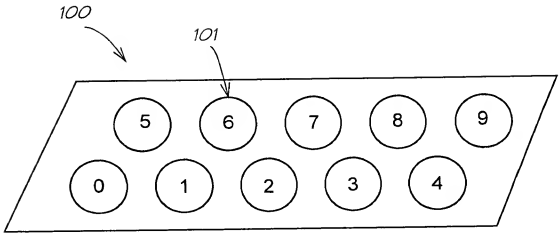


FIG. 10

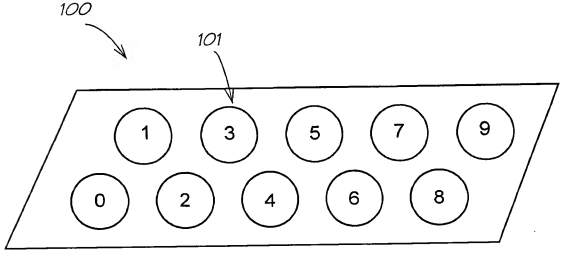


FIG. 11

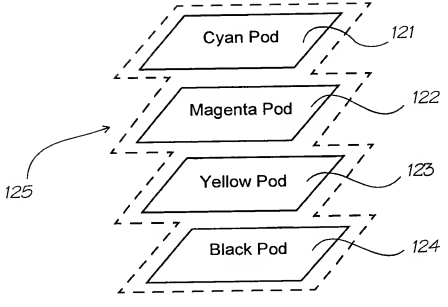
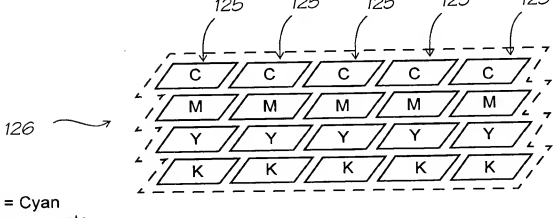


FIG. 12



C = Cyan
M = magenta
Y = Yellow
K = Black

FIG. 13

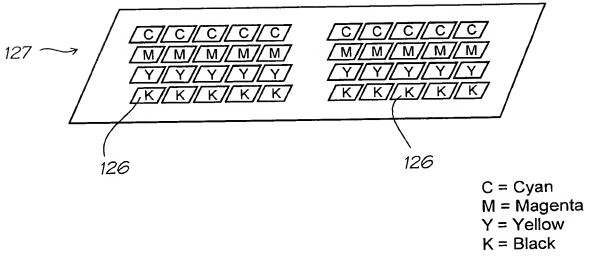

127
C C C C C
M M M M M
Y Y Y Y Y
K K K K K
126
126
C = Cyan
M = Magenta
Y = Yellow
K = Black

FIG. 14

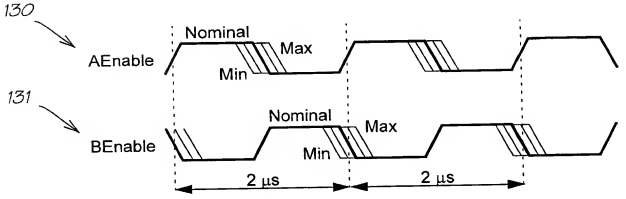

130
AEnable
Nominal
Max
Min
131
BEnable
Nominal
Max
Min
2 µs
2 µs

FIG. 16

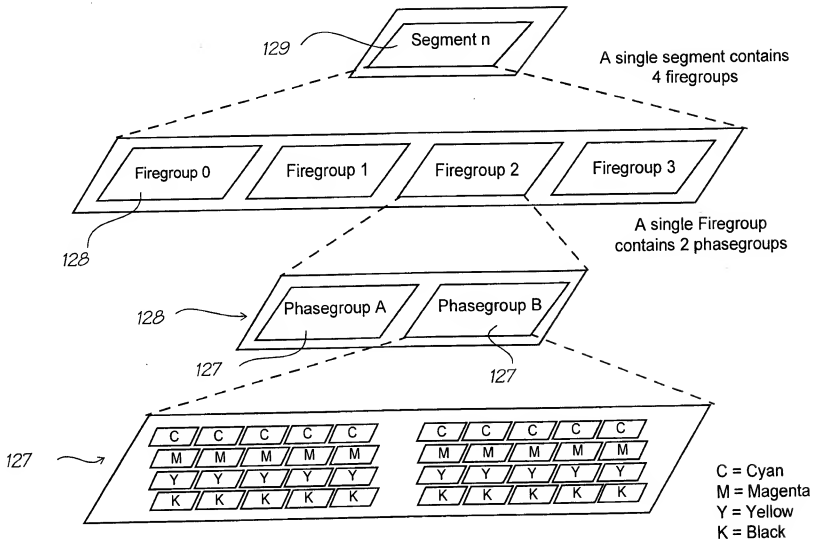

129
Segment n
A single segment contains
4 firegroups
Firegroup 0
Firegroup 1
Firegroup 2
Firegroup 3
128
A single Firegroup
contains 2 phasegroups
128
Phasegroup A
Phasegroup B
127
127
127
C C C C C
M M M M M
Y Y Y Y Y
K K K K K
C C C C C
M M M M M
Y Y Y Y Y
K K K K K
C = Cyan
M = Magenta
Y = Yellow
K = Black

FIG. 15

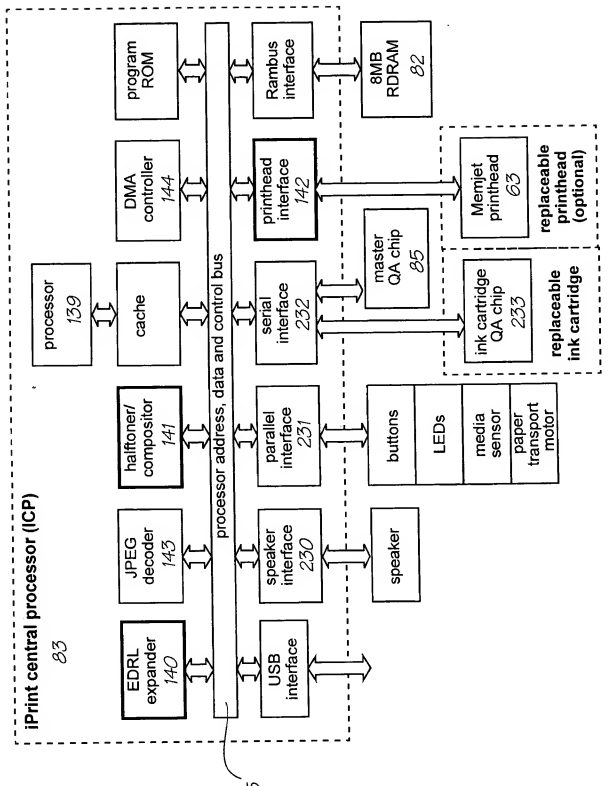

iPrint central processor (ICP)
83
processor
139
cache
DMA controller
144
program ROM
EDRL expander
140
JPEG decoder
143
halftoner/ compositor
141
processor address, data and control bus
Rambus interface
8MB RDRAM
82
USB interface
speaker interface
230
parallel interface
231
serial interface
232
printhead interface
142
master QA chip
85
145
speaker
buttons
LEDs
media sensor
paper transport motor
ink cartridge QA chip
233
Memjet printhead
63
replaceable ink cartridge
replaceable printhead (optional)

FIG. 17

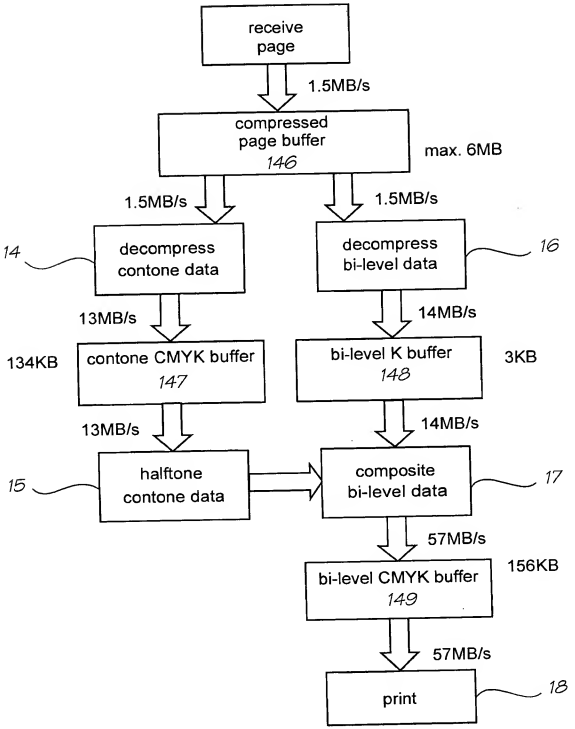

receive page
1.5MB/s
compressed page buffer 146
max. 6MB
1.5MB/s
1.5MB/s
14
decompress contone data
decompress bi-level data
16
13MB/s
14MB/s
134KB
contone CMYK buffer 147
bi-level K buffer 148
3KB
13MB/s
14MB/s
15
halftone contone data
composite bi-level data
17
57MB/s
bi-level CMYK buffer 149
156KB
57MB/s
print
18

FIG. 18

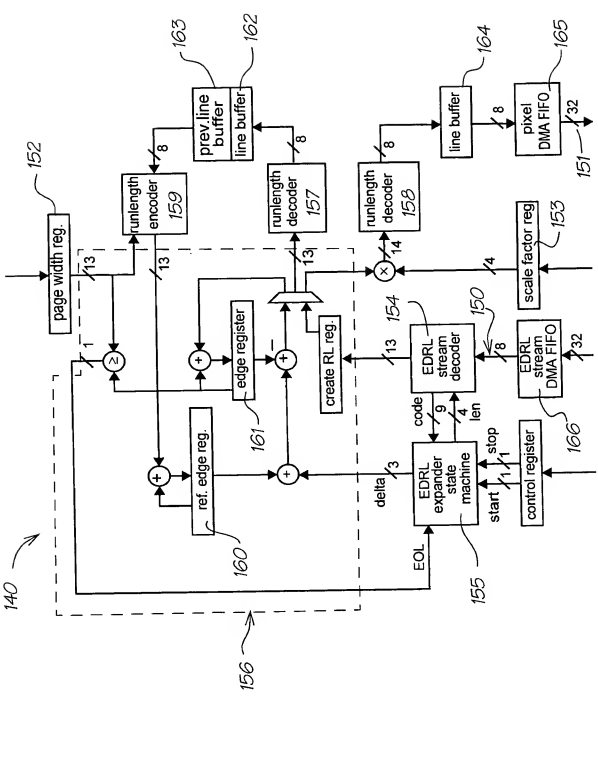

140
156
page width reg.
152
runlength encoder
159
prev. line buffer
line buffer
163
162
runlength decoder
157
runlength decoder
158
line buffer
164
pixel DMA FIFO
165
151
scale factor reg
153
edge register
161
create RL reg.
ref. edge reg.
160
EDRL stream decoder
154
150
EDRL stream DMA FIFO
166
EDRL expander state machine
155
control register
code
len
stop
start
delta
EOL

FIG. 19

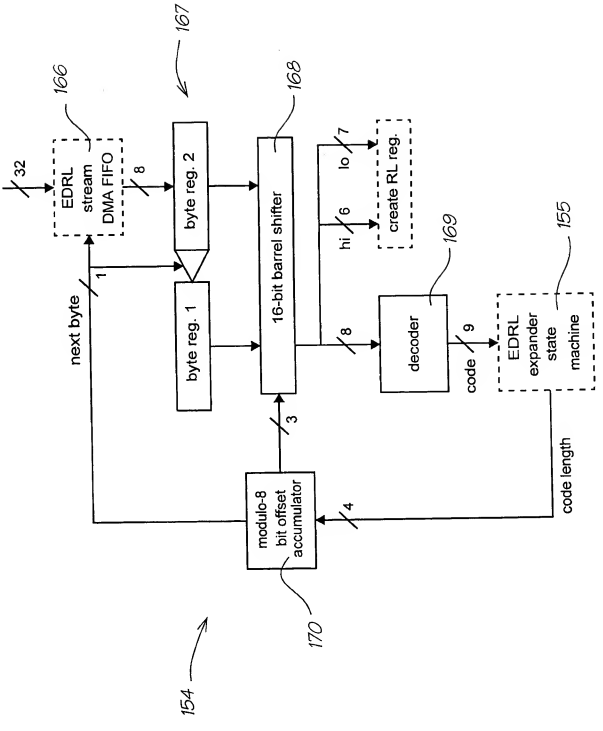

32
EDRL stream
DMA FIFO
8
166
167
byte reg. 2
byte reg. 1
16-bit barrel shifter
168
hi
6
lo
7
create RL reg.
next byte
1
8
decoder
169
code
9
EDRL expander state machine
155
code length
modulo-8 bit offset accumulator
3
4
170
154

FIG. 20

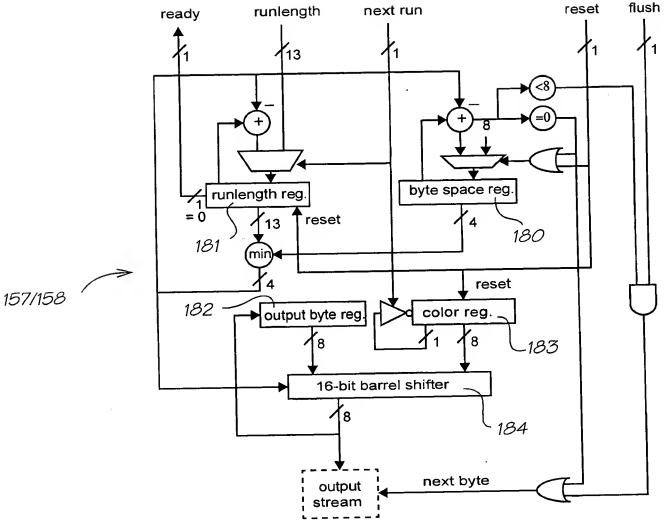

ready
runlength
next run
reset
flush
1
13
1
1
1
+
−
+
−
8
<8
=0
runlength reg.
byte space reg.
= 0
1
13
reset
4
181
180
min
4
reset
157/158
182
output byte reg.
color reg.
8
1
8
183
16-bit barrel shifter
8
184
output stream
next byte

FIG. 21

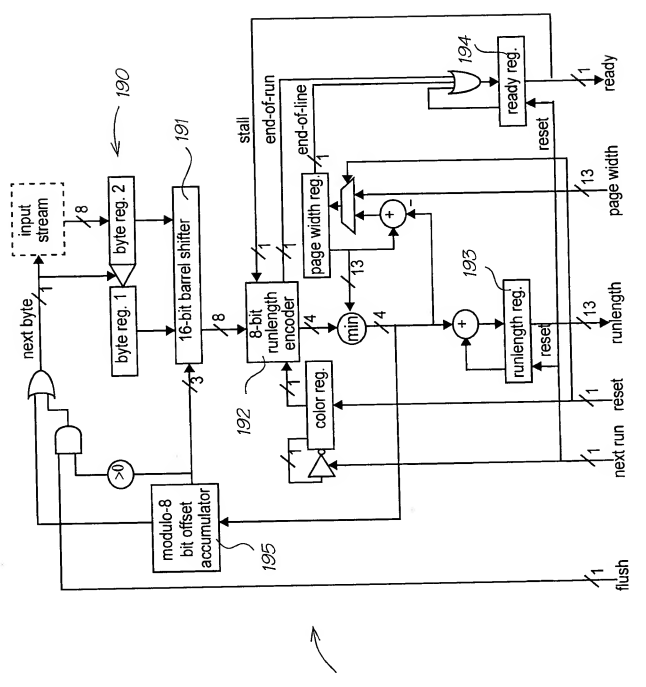

159
input stream
8
byte reg. 2
byte reg. 1
190
191
16-bit barrel shifter
next byte
stall
end-of-run
end-of-line
page width reg.
194
ready reg.
ready
reset
page width
13
8-bit runlength encoder
192
color reg.
min
193
runlength reg.
runlength
next run
reset
modulo-8 bit offset accumulator
195
flush

FIG. 22

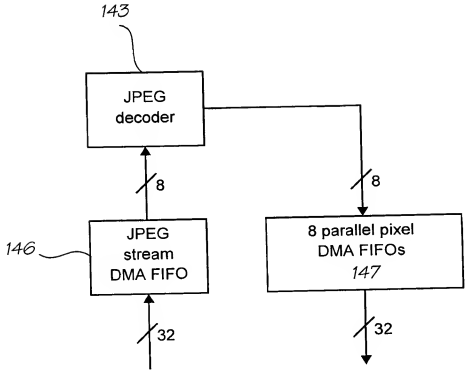

143
JPEG
decoder
8
8
146
JPEG
stream
DMA FIFO
8 parallel pixel
DMA FIFOs
147
32
32

FIG. 23

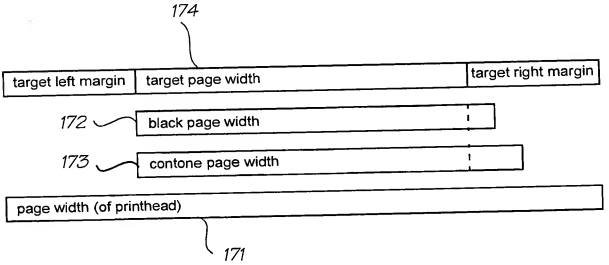

174
target left margin
target page width
target right margin
172
black page width
173
contone page width
page width (of printhead)
171

FIG. 25

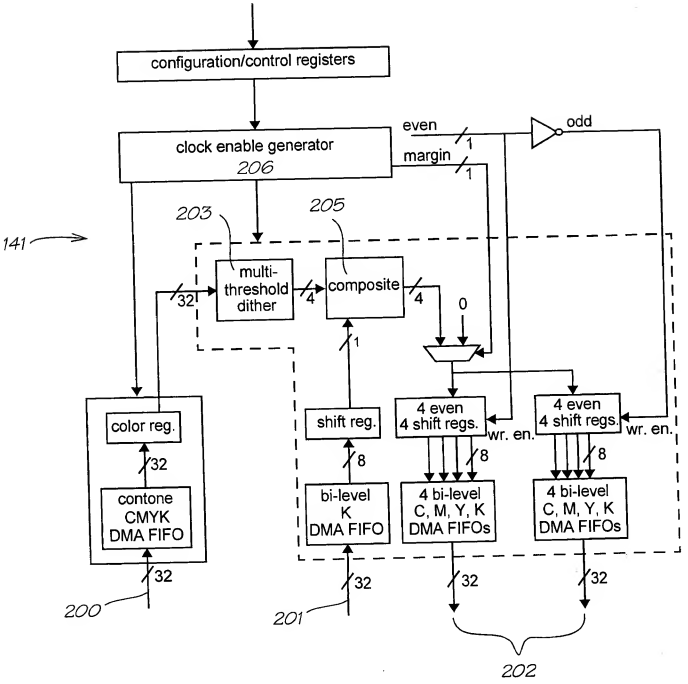

configuration/control registers
clock enable generator
206
even
odd
1
margin
1
203
205
141
multi-threshold dither
composite
32
4
4
0
1
color reg.
32
contone CMYK DMA FIFO
shift reg.
8
bi-level K DMA FIFO
4 even 4 shift regs.
wr. en.
8
4 bi-level C, M, Y, K DMA FIFOs
4 even 4 shift regs.
wr. en.
8
4 bi-level C, M, Y, K DMA FIFOs
32
32
32
32
200
201
202

FIG. 24

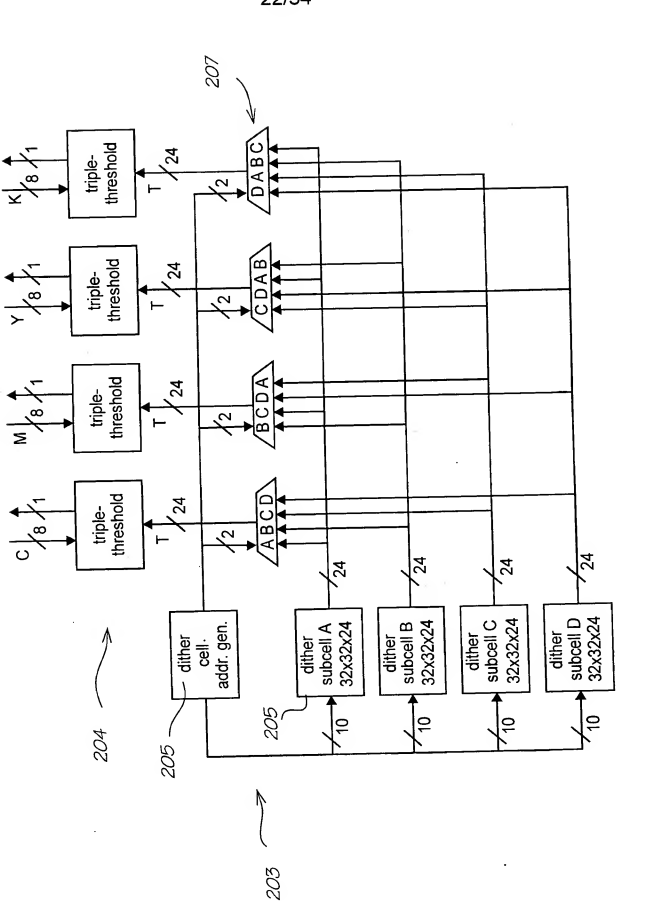

C
M
Y
K
8
1
triple-threshold
T
24
2
ABCD
BCDA
CDAB
DABC
207
204
205
dither cell-addr. gen.
dither subcell A 32x32x24
dither subcell B 32x32x24
dither subcell C 32x32x24
dither subcell D 32x32x24
10
203

FIG. 26

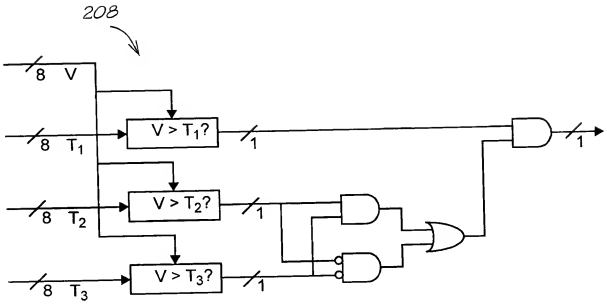

208
8 V
8 T1
8 T2
8 T3
V > T1?
V > T2?
V > T3?
1
1
1
1

FIG. 27

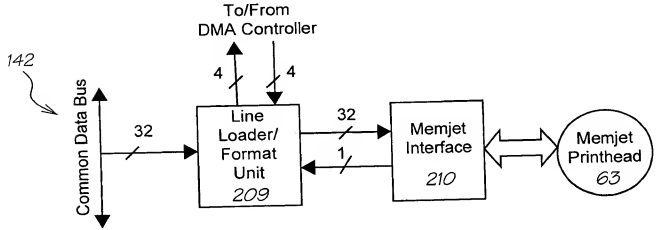

142
To/From
DMA Controller
4
4
Common Data Bus
32
Line
Loader/
Format
Unit
209
32
1
Memjet
Interface
210
Memjet
Printhead
63

FIG. 28

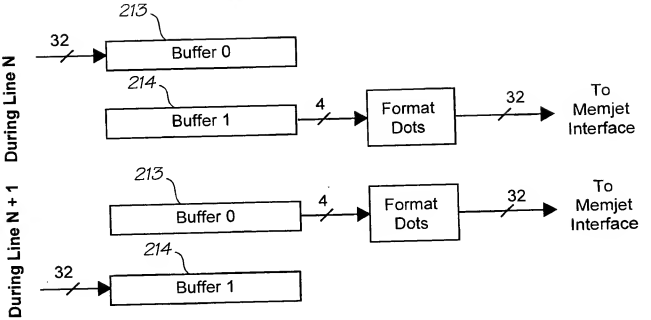

During Line N
During Line N + 1
213
214
32
Buffer 0
Buffer 1
4
Format Dots
32
To Memjet Interface

FIG. 29

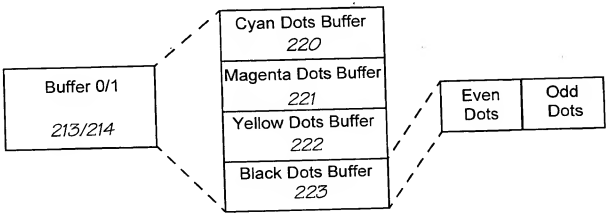

Buffer 0/1
213/214
Cyan Dots Buffer
220
Magenta Dots Buffer
221
Yellow Dots Buffer
222
Black Dots Buffer
223
Even Dots
Odd Dots

FIG. 31

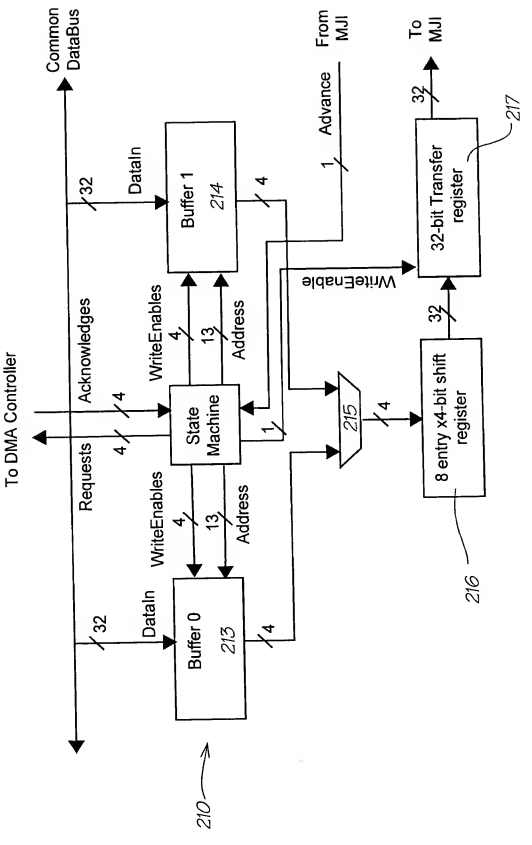

Common DataBus
To DMA Controller
Acknowledges
Requests
DataIn
WriteEnables
Address
Buffer 0
213
Buffer 1
214
State Machine
215
8 entry x4-bit shift register
216
32-bit Transfer register
217
Advance
From MJI
To MJI
WriteEnable
32
4
13
1
210

FIG. 30

213/214

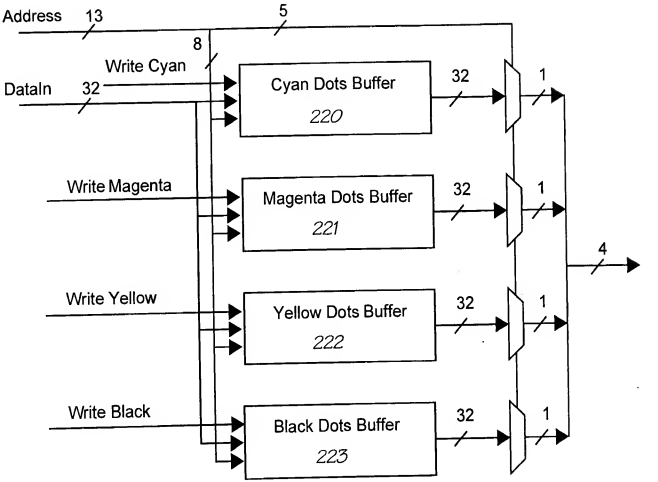


FIG. 32

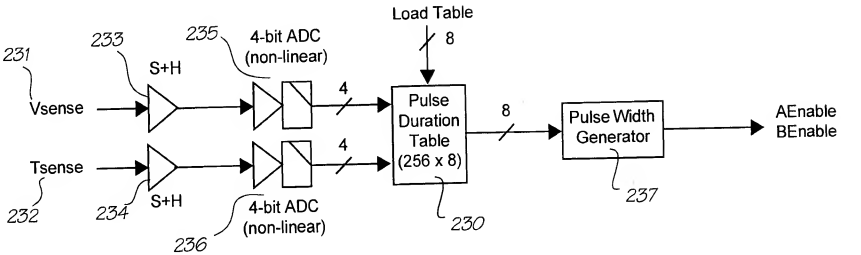

Load Table
8
231
233
235
4-bit ADC
(non-linear)
S+H
Vsense
4
Pulse
Duration
Table
(256 x 8)
8
Pulse Width
Generator
AEnable
BEnable
Tsense
4
232
234
S+H
4-bit ADC
(non-linear)
236
230
237

FIG. 33

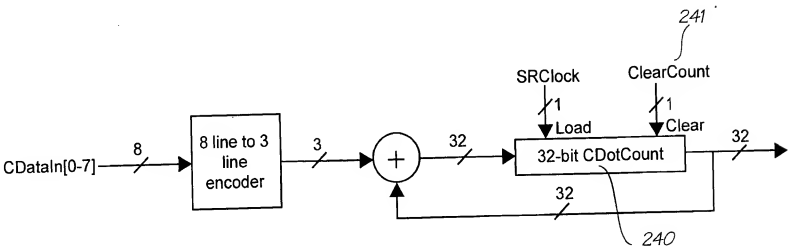

241
SRClock
ClearCount
1
1
Load
Clear
CDataIn[0-7]
8
8 line to 3
line
encoder
3
32
32-bit CDotCount
32
32
240

FIG. 34

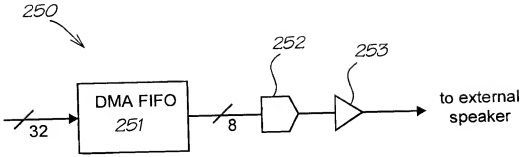

250
252
253
DMA FIFO
251
32
8
to external
speaker

FIG. 35

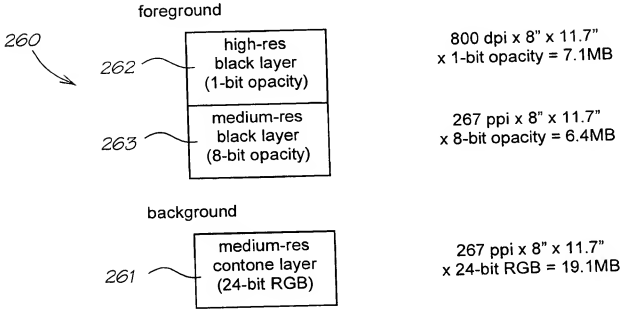

foreground
260
262
high-res
black layer
(1-bit opacity)
800 dpi x 8" x 11.7"
x 1-bit opacity = 7.1MB
263
medium-res
black layer
(8-bit opacity)
267 ppi x 8" x 11.7"
x 8-bit opacity = 6.4MB
background
261
medium-res
contone layer
(24-bit RGB)
267 ppi x 8" x 11.7"
x 24-bit RGB = 19.1MB

FIG. 36

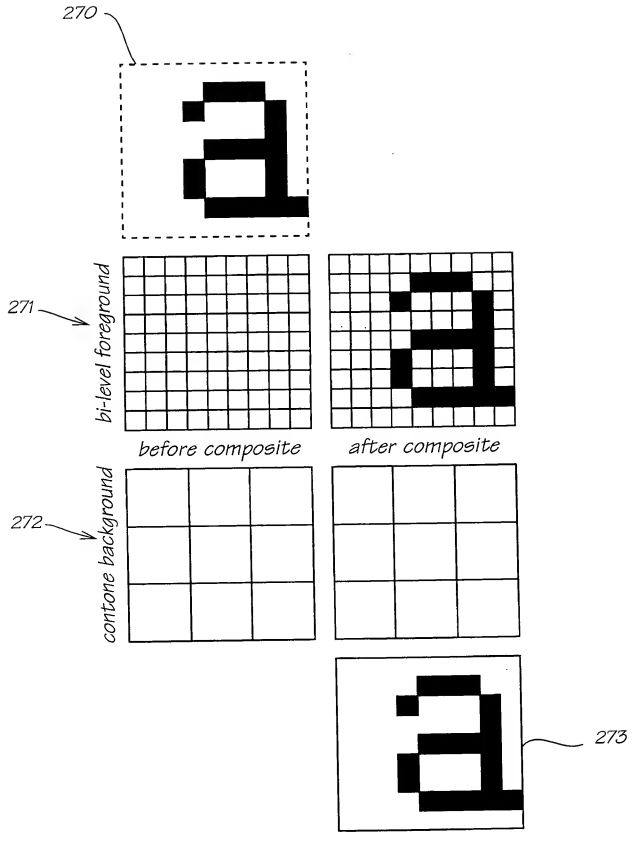

270
271
bi-level foreground
before composite
after composite
272
contone background
273

FIG. 37

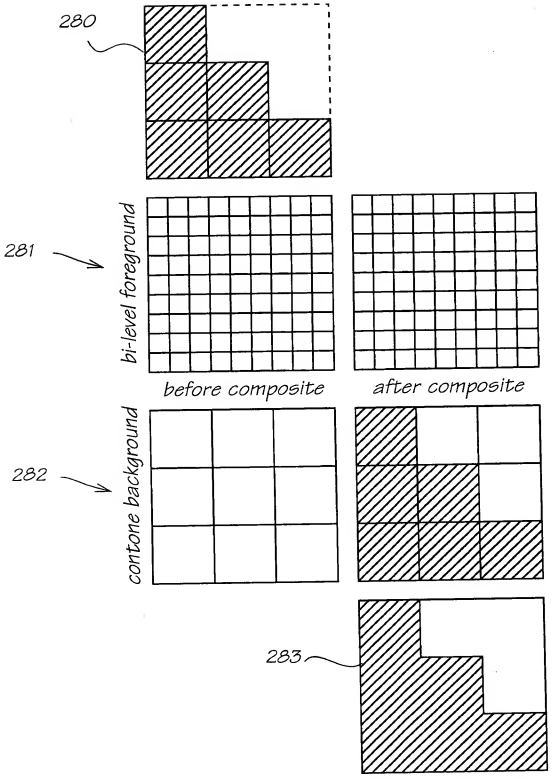

280
281
bi-level foreground
before composite
after composite
282
contone background
283

FIG. 38

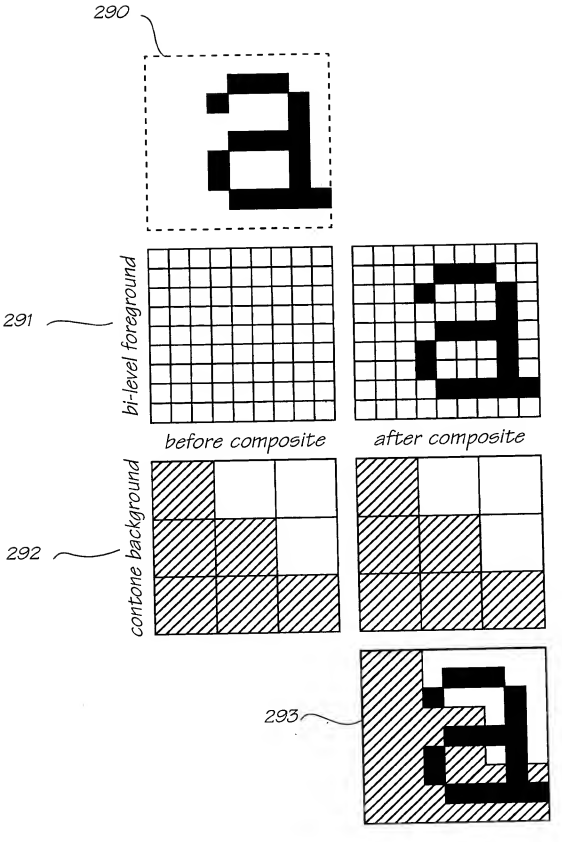

290
291
bi-level foreground
before composite
after composite
292
contone background
293

FIG. 39

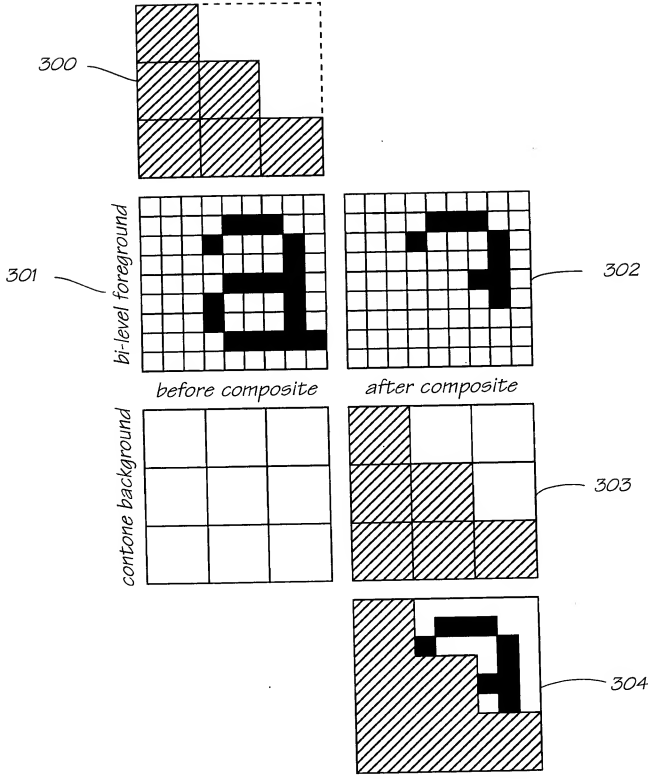

300
301
bi-level foreground
302
before composite
after composite
contone background
303
304

FIG. 40

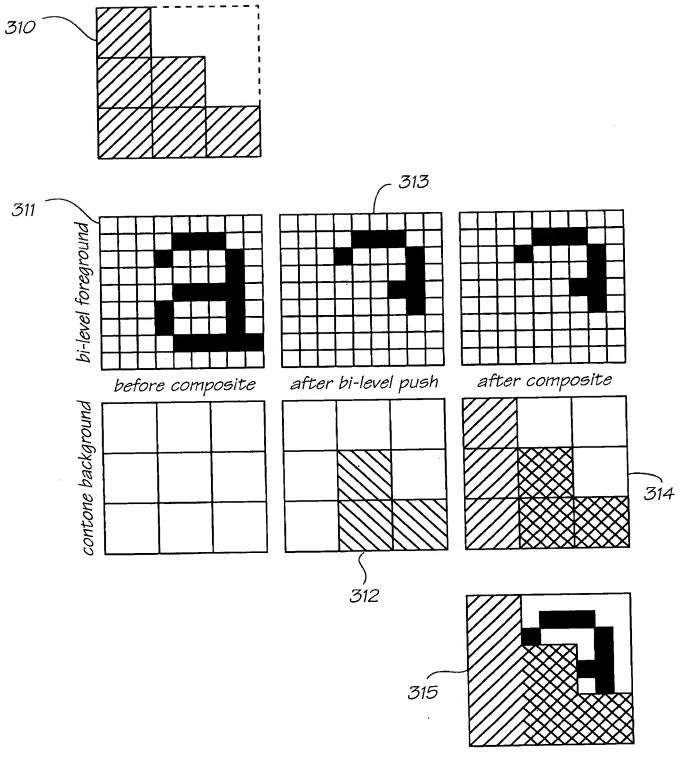

310
311
313
bi-level foreground
before composite
after bi-level push
after composite
contone background
314
312
315

FIG. 41

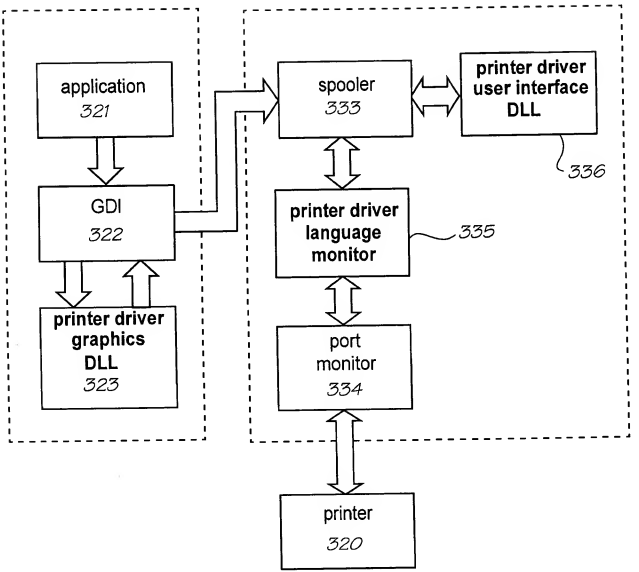

application
321
GDI
322
printer driver
graphics
DLL
323
spooler
333
printer driver
user interface
DLL
336
printer driver
language
monitor
335
port
monitor
334
printer
320

FIG. 42